



UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

(Approved by AICTE and recognized by UGC, Ministry of HRD, Govt. of INDIA)

'Gurukul', 6 Kms. from Chomu on Sikar Road, Udaipuria Mod, Chomu, Jaipur-303807 (Rajasthan)

Phone : 01423-205168, Fax : +91 8302542610, Email: vc@uem.edu.in, Website : www.uem.edu.in

Proposed Agenda Note – Meeting of Board of Studies Date –10th July 2024

Agenda for meeting of Board of Studies of **Department of Mechanical Engineering**

Scheduled at 2:30 PM on 10th July 2024 as below mentioned:

1. To Confirm the Minutes of Meeting of last BOS meeting of the department.
2. To read Action Taken Report for agendas of last meeting of BOS of the department.
3. To report on updating/ modification / restructuring of syllabus for next academic session keeping in view of the policy for common syllabus for all the institutions of the IEM-UEM group.
4. To report on course mapping for current syllabus and online certifications from Infosys Springboard, Coursera and LinkedIn Learning.
5. Any other inputs by the external BOS members.

Minutes of Meeting of Board of Studies for Department of Mechanical Engineering, University of Engineering & Management, Jaipur held on Date – 10th July 2024.

The Meeting of Board of Studies for Department of Mechanical Engineering was held on 10th July 2024 at 2:30 PM in at University of Engineering & Management Jaipur city office. The following members were present:

1. Dr. Umesh Gurnani, Associate Prof. & Head of Department, Mechanical Engineering, UEM Jaipur.
2. Prof. T. K. Sen, Professor, Mechanical Engineering, UEM Jaipur.
3. Prof. Anurag Hamilton, Professor, Mechanical Engineering, UEM Jaipur.
4. Mr. Iqbal Ahmad, Assistant Professor, Mechanical Engineering, UEM Jaipur.
5. Mr. Sasthi Charan Hens, Assistant Professor, Mechanical Engineering, UEM Jaipur.
6. Mr. Ravindra Maanju, Assistant Professor, Mechanical Engineering, UEM Jaipur.
7. Mr. Vinod Yadav, Assistant Professor, Mechanical Engineering, UEM Jaipur.
8. Prof. (Dr.) G.S. Dangayach, Professor (HAG), Mechanical Engineering, MNIT Jaipur
9. Dr. M. L. Meena, Associate Professor, Mechanical Engineering, MNIT Jaipur
10. Mr. Nitin Jhanwar, Director, Accurate Solutions, Jaipur.

Dr. Umesh Gurnani, Head of Department, Mechanical Engineering, UEM Jaipur welcomed all the members of Board of Studies before commencement of the meeting. Thereafter agenda points of the meeting of Board of Studies were taken up for discussion.

The Board of Studies of Department of Mechanical Engineering, UEM Jaipur took the following resolutions:

Agenda Item No-1:

To Confirm the Minutes of Meeting of last BOS meeting of the Department of Mechanical Engineering

The minutes of the last meeting of Board of studies was circulated to all the members in advance through mail. As there was no observation raised in the meeting, it was confirmed.

Agenda Item No-2:

To read the Action Taken Report of last Board of Studies meeting held on 11.12.2023.

The agenda wise Action Taken Report of the last meeting of Board of Studies for Department of Mechanical Engineering held on 11th Dec 2023, was circulated to all the members in advance through mail. As there was no observation raised, it was confirmed.

Agenda Item No-3

To report on updating/modification/restructuring of syllabus for next academic session keeping in view of the policy for common syllabus for all the institutions of the IEM-UEM group.

The syllabus was updated and restructured after modification including all important content which was decided by members of board of studies keeping in view the model curriculum shared by AICTE. The organization is willing to have a common syllabus for all the institutions run by IEM-UEM group. A detailed mapping of syllabus in line with MIT online courses and AICTE model curriculum have also been added in detailed syllabus to ensure that all topics including technological advancements are covered

students of Mechanical Engineering. Apart from discussion on credit points of each subject, placing the subjects in right year and right semester was also ensured by the BOS team.

- * All the points in syllabus were highly appreciated by members and inputs were received by them for successful implementation of those points. The inputs on marks for extracurricular activities were also noted.

Agenda Item No-4

To report on course mapping for current syllabus and online certifications from Infosys Springboard and LinkedIn Learning.

The online certification programs for students of Mechanical Engineering have been introduced with respect to a MoU signed with Infosys Springboard team to make them learn and interact directly with corporate trainers regarding the need of industry. Infosys will be leading this online platform and providing maximum possible courses relevant to students of Engineering to enhance their know-how about the technological advancements. A similar platform is also shared by LinkedIn Learning which includes similar courses where students are being encouraged by teachers to join and begin a new era of hybrid learning.

Agenda Item No-5

Any other inputs by the external BOS members

Few of the below mentioned points were shared by External members to be incorporated in UEMJ curriculum.

1. The Heat Transfer and Thermal Machines (PCCME501) course name is unjustified because there are no modules related to thermal machines in the syllabus.
2. The course content was better represented by 'design' instead of 'drawing' in Machine Drawing (PCCME592).
3. Name of Universal Human Values-2(HSMME801) course should be changed to Universal human values.
4. In Open Elective-III (OECME801) course, Artificial Intelligence should also be added with Machine Learning.
5. The course contents of Machine Element & System Design (PCCME502) is lengthy, steps should be taken to ensure that entire syllabus is completed within given time period.

The meeting ended with a vote of thanks to the chair.

Attendance Sheet for Meeting of Board of Studies

Department of Mechanical Engineering

University of Engineering & Management, Jaipur

Date - 10th July 2024

S.no.	Name	Designation	Signature
1	Dr. Umesh Gurnani	Head of Department, Mechanical Engineering, UEM Jaipur (Chairman)	
2.	Prof. T. K. Sen	Professor, Department of Mechanical Engineering, UEM Jaipur (Member)	
3.	Prof. Anurag Hamilton	Professor, Department of Mechanical Engineering, UEM Jaipur (Member)	
4.	Iqbal Ahmad	Assistant Professor, Department of Mechanical Engineering, UEM Jaipur (Member)	
5.	Sasthi Charan Hens	Assistant Professor, Department of Mechanical Engineering, UEM Jaipur (Member)	
6.	Ravindra Maanju	Assistant Professor, Department of Mechanical Engineering, UEM Jaipur (Member)	
7.	Vinod Yadav	Assistant Professor, Department of Mechanical Engineering, UEM Jaipur (Member)	
8.	Prof. G.S. Dangayach	Professor (HAG), Department of Mechanical Engineering, MNIT Jaipur	
9.	Dr. M. L. Meena,	Associate Professor, Department of Mechanical Engineering, MNIT Jaipur	
10.	Mr. Nitin Jhanwar	Director, Accurate Solutions, Jaipur	P. (online)

EXECUTIVE CREDIT SUMMARY OF PROPOSED SYLLABUS

SEM	AICTE	IEM (AUTONOMY)	MOOCS*	Minor
1st	20	23.5	SWAYAM/ NPTEL 20	20
2nd	20	23.5		
3rd	22	22		
4th	22	21		
5th	21	23		
6th	23	24		
7th	18	17		
8th	14	11		
Total	160	165	185	205

EXECUTIVE CREDIT SUMMARY OF PROPOSED SYLLABUS									
ALONG WITH COMPARISON WITH AICTE MODEL SYLLABUS									
SEMESTER	HSMC	BSC	ESC	PCC	PEC	OEC	PRJ & SEMINAR	TOTAL	
1st	4	9.5	10					23.5	
2nd	1	12.5	10					23.5	
3rd	1	3	6	11			1	22	
4th	1	3		16			1	21	
5th	2			17	3		1	23	
6th	4			14.5	3		2.5	24	
7th	4				3	6	4	17	
8th	3					3	5	11	
TOTAL	20	28	26	58.5	9	9	14.5	165	
AICTE	12	29	27	58	9	9	16	160	

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UEM Jaipur Campus

New Syllabus Outline Structure

For

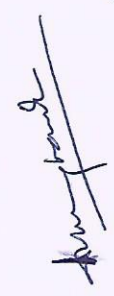
B.Tech in Mechanical Engineering

Effective from Academic Year 2024-2025

DEPARTMENT OF MECHANICAL ENGINEERING

3rd SEMESTER

Sl. No.	Category	Code	Course Title	Hours per week			Total contact hours	Credits
Theory Papers								
1	BSC	BSM301	Mathematics - III	L	T	P	3	3
2	ESC	ESCME302	Engineering Thermodynamics	3	1	0	4	4
3	PCC	PCCME301	Engineering Materials & Applications	2	1	0	3	3
4	PCC	PCCME302	Mechanics of Deformable Solids	2	1	0	3	3
5	PCC	PCCME303	Manufacturing Process- I	2	1	0	3	3
6	HSMC	ESP301	Essentials Studies for Professionals – III	2	0	0	2	0.5
Practical/ Sessional Papers								
7	ESC	ESCME381	Basic Electronics Engineering	0	1	2	3	2
8	PCC	PCCME391	Mechanical Engg Lab IA (Materials Testing)	0	0	2	2	1
9	PCC	PCCME392	Mechanical Engg Lab IIA (Manufacturing Process)	0	0	2	2	1
10	PRJ	PRJME381	Project I (CAD Based)	0	0	2	2	1
11	HSMC	SDP381	Skill Development for Professionals –III	0	0	2	2	0.5
TOTAL							29	22
For B.Tech Honours Degree								
12	MOOCs	MOOCS	MOOCs Certificate Courses (NPTEL/SWAYAM)	-	-	-	-	-
For B.Tech with Minor Degree in Robotics								
13	MD	RBME301	Introduction to Robotics	3	1	0	4	4
For B.Tech with Minor Degree in Sustainable Energy Engineering								
14	MD	SEEME301	Energy and its Resources	1	1	2	3	3
Mandatory Courses								
15	MC	IFC	Industry and Foreign Certification (IFC)	-	-	-	-	-
16	MC	MAR	Mandatory Additional Requirements (MAR)	-	-	-	-	-


4th SEMESTER

Sl. No.	Category	Code	Course Title	Hours per week			Total contact hours	Credits
Theory Papers								
1	BSC	BSM401	Mathematics- IV	L	T	P	3	3
2	PCC	PCCME401	Fluid Mechanics & Fluid Machines	3	1	0	4	4
3	PCC	PCCME402	Kinematics & Dynamics of Machines	2	1	0	3	3
4	PCC	PCCME403	Internal Combustion Engine & Gas Turbine	2	1	0	3	3
5	PCC	PCCME404	Measurements & Metrology	2	1	0	3	3
6	HSMC	ESP401	Essentials Studies for Professionals – IV	2	0	0	2	0.5
Practical / Sessional Papers								
7	PCC	PCCME491	Mechanical Engg Lab IIIA (Fluid Mechanics)	0	0	2	2	1
8	PCC	PCCME492	Mechanical Engg Lab IIIB (IC Engine)	0	0	2	2	1
9	PCC	PCCME493	Mechanical Engg Lab IIB (Measurements & Metrology)	0	0	2	2	1
10	PRJ	PRJME481	Project II (Research Methodology)	0	0	2	2	1
11	MC	MCME481	Environmental Science (Audit)	0	0	2	2	0
12	HSMC	SDP481	Skill Development for Professionals -IV	0	0	2	2	0.5
TOTAL							30	21
For B.Tech Honours Degree								
13	MOOCs	MOOCs	MOOCs Certificate Courses (NPTEL/SWAYAM)	-	-	-	-	-
For B.Tech with Minor Degree in Robotics								
14	MD	RBME401	Mechanics of Robots	3	0	0	3	3
For B.Tech with Minor Degree in Sustainable Energy Engineering								
15	MD	SEEME401	Climate Change Understanding & Observations	1	1	2	3	3
Mandatory Courses								
16	MC	IFC	Industry and Foreign Certification (IFC)	0	0	0	0	0
17	MC	MAR	Mandatory Additional Requirements (MAR)	0	0	0	0	0






5th SEMESTER

SL NO	Category	Paper Code	Paper Name	L	T	P	Total Contact Hrs	Credits
Theory Papers								
1	PCC	PCCME501	Heat Transfer & Thermal Machines	3	1	0	4	4
2	PCC	PCCME502	Machine Element & System Design	3	1	0	4	4
3	PCC	PCCME503	Manufacturing Process- II	3	0	0	3	3
4	PCC	PCCME504	Mechatronics, Robotics & Control	2	0	0	2	2
5	PEC	PECME501	Professional Elective - I	3	0	0	3	3
6	HSMC	ESPMME501	Essential Studies for Professionals (ME) - V	2	0	0	2	0.5
Practical / Sessional Papers								
7	PCC	PCCME591	Mechanical Engg Lab IIIC (Applied Thermodynamics & Heat Transfer)	0	0	2	2	1
8	PCC	PCCME592	Mechanical Engg Lab IB (Machine Drawing)	0	0	2	2	1
9	PCC	PCCME593	Mechanical Engg Lab IC (Kinematics & Dynamics of Machines)	0	0	2	2	1
10	PCC	PCCME594	Mechatronics, Robotics & Control Lab	0	0	2	2	1
11	PRJ	PRJME581	Project-III	0	0	2	2	1
12	HSMC	SDP581	Skill Development for Professionals - V	0	0	2	2	0.5
13	HSMC	HSMME582	Seminar & Communication 2	0	0	2	2	1
TOTAL							32	23
For B.Tech Honours Degree								
15	MOOCs	MOOCs	MOOCs Certificate Courses (NPTEL/SWAYAM)	-	-	-	-	-
For B.Tech with Minor Degree in Robotics								
16	MD	RBME501	Microprocessors & Embedded Systems	3	0	2	5	4
For B.Tech with Minor Degree in Sustainable Energy Engineering								
17	MD	SEEME501	Energy storage systems for renewables	1	1	2	3	3
Mandatory Courses								
18	MC	IFC	Industry and Foreign Certification (IFC)	0	0	0	0	0
19	MC	MAR581	Mandatory Additional Requirements (MAR)	0	0	0	0	0






List of Professional Electives for Elective-I

- A. Mechanical Vibration
- B. Advanced Welding Technology
- C. Micro and Nano Manufacturing
- D. Power Plant Engineering
- E. Die, Mould and Tool Engineering

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6th SEMESTER

SL NO	Category	Paper Code	Paper Name	L	T	P	Total Contact (Hrs)	Credits
Theory Papers								
1	PCC	PCCME601	Computer Aided Design & Analysis	2	0	0	2	2
2	PCC	PCCME602	Manufacturing Automation	3	0	0	3	3
3	PCC	PCCME603	Production & Operation Management	2	1	0	3	3
4	PEC	PECME601	Professional Elective- II	3	0	0	3	3
5	HSMC	HSMMME601	HSS/Management Elective-1 (1. Project Management/ 2. Finance & Accounting)	3	0	0	3	3
6	HSMC	ESPME601	Essentials Studies for Professionals – VI	2	0	0	2	0.5
Practical / Sessional Papers								
7	PCC	PCCME681	Product Innovation & Entrepreneurship	0	2	2	4	3
8	PCC	PCCME691	Mechanical Engg Lab IIC (Advanced Manufacturing & Automation)	0	0	3	3	1.5
9	PCC	PCCME692	Mechanical Engg Lab ID (Computer Aided Design & Analysis)	0	0	2	2	1
10	PCC	PCCME693	Mechanical Engg Lab IID (Refrigeration and Air Conditioning)	0	0	2	2	1
11	PRJ	PRJME681	Project-IV (Minor)	0	0	5	5	2.5
12	HSMC	SDP681	Skill Development for Professionals -VI	0	0	2	2	0.5
TOTAL							34	24
For B.Tech Honours Degree								
14	MOOCs	MOOCs	MOOCs Certificate Courses (NPTEL/SWAYAM)	-	-	-	-	-
For B.Tech with Minor Degree in Robotics								
15	MD	RBME601	Control of Robotic Systems	3	0	0	3	3
For B.Tech with Minor Degree in Sustainable Energy Engineering								
16	MD	SEEME601	Electronics for Renewables	1	1	2	3	3
Mandatory Courses								
17	MC	IFC	Industry and Foreign Certification (IFC)	0	0	0	0	0
18	MC	MAR	Mandatory Additional Requirements (MAR)	0	0	0	0	0





List of Professional Electives for Elective-II

- A. Computational Fluid Dynamics
- B. Refrigeration and Air Conditioning
- C. Turbo Machinery
- D. Finite Element Analysis
- E. Composite Materials
- F. Design for Manufacturing & Assembly
- G. Additive Manufacturing
- H. Tribology

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7th SEMESTER

SL NO	Category	Paper Code	Paper Name	L	T	P	Total Contact Hrs	Credits
Theory Papers								
1	PEC	PECME701	Professional Elective -III	3	0	0	3	3
2	OEC	OECME701	Open Elective-I	3	0	0	3	3
3	OEC	OECME702	Open Elective-II	3	0	0	3	3
4	HSMC	HSMME701	HSS/Management Elective-2 (1. Industrial Psychology/ 2. Operation Research)	3	0	0	3	3
5	HSMC	ESPME701	Essential Studies for Professionals (ME) - VII	2	0	0	2	0.5
Practical / Sessional Papers								
6	PRJ	PRJME781	Project-V	0	0	8	8	4
7	HSMC	SDP781	Skill Development for Professionals - VII	0	0	2	2	0.5
TOTAL							24	17
For B.Tech Honours Degree								
8	MOOCS	MOOCS	MOOCs Certificate Courses (NPTEL/SWAYAM)	-	-	-	-	-
For B.Tech with Minor Degree in Robotics								
9	MD	RBME781	Project in Robotics I	1	0	2	3	2
For B.Tech with Minor Degree in Sustainable Energy Engineering								
10	MD	SEEME701	Solar Energy Technologies and System Design	1	1	2	3	3
Mandatory Courses								
11	MC	IFC	Industry and Foreign Certification (IFC)	0	0	0	0	0
12	MC	MAR	Mandatory Additional Requirements (MAR)	0	0	0	0	0

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List of Professional Electives for Elective-III

A. Automobile Engineering	F. Agricultural Engineering
B. Material Handling	G. Biomedical Engineering
C. Industrial Engineering	H. Food Technology
D. Industrial Robotics	I. Nuclear Engineering
E. Aerospace Engineering	

List of Open Electives for Open Elective-I

- A. Principal & Practice of management
- B. Process Planning and Cost Estimation
- C. Data Analytics
- D. Renewable Energy Engineering

List of Open Electives for Open Elective-II

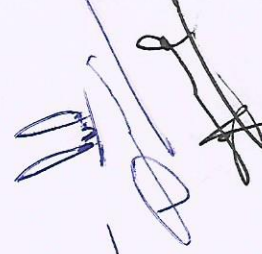
- A. Industry 4.0
- B. 3D Printing Technology
- C. Optimization Techniques

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8th SEMESTER

SL NO	Category	Paper Code	Paper Name	L	T	P	Total Contact Hrs	Credits
Theory Papers								
1	HSMC	HSMME801	Universal Human Values-2	2	0	0	2	2
2	OEC	OECME801	Open Elective-III	3	0	0	3	3
3	HSMC	ESP802	Essential Studies for Professionals - VIII	2	0	0	2	0.5
Practical / Sessional Papers								
4	PRJ	PRJME881	Project-VI (Prototype & Testing)	0	0	8	8	4
5	PRJ	PRJME882	Comprehensive viva	0	0	0	0	1
6	HSMC	SDP881	Skill Development for Professionals - VIII	0	0	2	2	0.5
TOTAL							17	11
For B.Tech Honours Degree								
7	MOOCS	MOOCS	MOOCs Certificate Courses (NPTEL/SWAYAM)	-	-	-	-	-
For B.Tech with Minor Degree in Robotics								
8	MD	RBME881	Project in Robotics II	0	0	4	4	2
For B.Tech with Minor Degree in Sustainable Energy Engineering								
9	MD	SEEME801	Solar Energy System Installations and Maintenance	1	1	2	3	3
Mandatory Courses								
10	MC	IFC	Industry and Foreign Certification (IFC)	0	0	0	0	0
11	MC	MAR	Mandatory Additional Requirements (MAR)	0	0	0	0	0





List of Open Electives for Elective-III

- A. Total Quality Management
- B. Maintenance Engineering
- C. Quality & Reliability Engineering
- D. Machine Learning
- E. Biomechanics & Biomaterials

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UNIVERSITY OF ENGINEERING & MANAGEMENT
Good Education, Good Jobs

UEM Jaipur Campus

New Syllabus Outline Structure

For

5th SEMESTER (B.Tech in Mechanical Engineering)

Effective from Academic Year 2024-2025

DEPARTMENT OF MECHANICAL ENGINEERING

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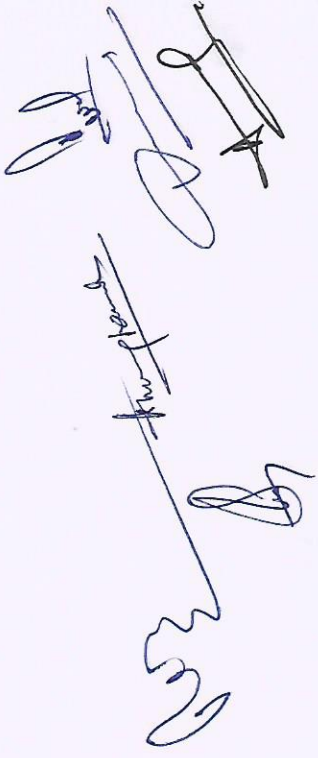
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5th SEMESTER

SL NO	Category	Paper Code	Paper Name	L	T	P	Total Contact Hrs	Credits
Theory Papers								
1	PCC	PCCME501	Heat Transfer & Thermal Machines	3	1	0	4	4
2	PCC	PCCME502	Machine Element & System Design	3	1	0	4	4
3	PCC	PCCME503	Manufacturing Process- II	3	0	0	3	3
4	PCC	PCCME504	Mechatronics, Robotics & Control	2	0	0	2	2
5	PEC	PECME501	Professional Elective - I	3	0	0	3	3
6	HSMC	ESPME501	Essential Studies for Professionals (ME) - V	2	0	0	2	0.5
Practical / Sessional Papers								
7	PCC	PCCME591	Mechanical Engg Lab IIIC (Applied Thermodynamics & Heat Transfer)	0	0	2	2	1
8	PCC	PCCME592	Mechanical Engg Lab IB (Machine Drawing)	0	0	2	2	1
9	PCC	PCCME593	Mechanical Engg Lab IC (Kinematics & Dynamics of Machines)	0	0	2	2	1
10	PCC	PCCME594	Mechatronics, Robotics & Control Lab	0	0	2	2	1
11	PRJ	PRJME581	Project-III	0	0	2	2	1
12	HSMC	SDP581	Skill Development for Professionals - V	0	0	2	2	0.5
13	HSMC	HSMME582	Seminar & Communication 2	0	0	2	2	1
TOTAL							32	23
For B.Tech Honours Degree								
15	MOOCs	MOOCs	MOOCs Certificate Courses (NPTEL/SWAYAM)	-	-	-	-	-
For B.Tech with Minor Degree in Robotics								
16	MD	RBME501	Microprocessors & Embedded Systems	3	0	2	5	4
For B.Tech with Minor Degree in Sustainable Energy Engineering								
17	MD	SEEME501	Energy storage systems for renewables	1	1	2	3	3
Mandatory Courses								
18	IFC	IFC	Industry and Foreign Certification (IFC)	0	0	0	0	0
19	MAR	MAR581	Mandatory Additional Requirements (MAR)	0	0	0	0	0

List of Professional Electives for Elective-I

- A. Mechanical Vibration
- B. Advanced Welding Technology
- C. Micro and Nano Manufacturing
- D. Power Plant Engineering
- E. Die, Mould and Tool Engineering

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Subject Name: Heat Transfer & Thermal Machines

Credit: 4

Subject Code: PCCME501

Lecture Hours: 48

Pre-requisite: Engineering Thermodynamics, IC Engine and Gas Turbine

Relevant Links: STUDY MATERIAL

NPTEL

COURSE OBJECTIVES:

The purpose of learning this course is to:

1. Build a solid foundation in heat transfer, exposing students to the three basic modes namely conduction, convection and radiation.
2. Rigorous treatment of governing equations and solution procedures for the three modes, along with solution of practical problems using empirical correlations.
3. The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

COURSE OUTCOMES:

At the end of this course students will demonstrate the ability to

CO1: Recognize and understand the mechanisms underlying conduction, convection, and radiation heat transfer.

CO2: Apply mathematical models of heat transfer to solve practical problems, including heat conduction through solids, convective heat transfer in fluids, and radiative heat exchange between surfaces.

CO3: Analyze complex heat transfer problems to identify relevant parameters and boundary conditions for providing solutions in practical engineering scenarios.

CO4: Evaluate the effectiveness and efficiency of different heat transfer mechanisms in various applications and create innovative solutions to enhance heat transfer phenomenon in engineering systems.

Module number	Topic	Sub-topics	Book name and chapter	Mapping with Industry and International Academia	Lecture Hours	Corresponding Assignment
1	Introduction	Three modes of heat transfer; Examples of equipment (like air conditioner and air cooler) involving heat transfer; Derivation of heat balance equation. Fourier and separation of variables techniques.	Yunus A. Cengel & Afsin J. Ghajar, Heat & Mass Transfer, Chapter 1.	International Standard: https://ocw.mit.edu/courses/2-051-introduction-to-heat-transfer-fall-2015/pages/syllabus/ AICTE-prescribed syllabus: https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf https://www.iitbbs.ac.in/mtech-thermal-science-and-engineering.php Industry Mapping: MATLAB	6	1. Determination of the thermal conductivity and specific heat of given objects. 2. Solve 1d numerical problems of heat transfer with MATLAB.
2	Conduction Heat Transfer	Steady 1D solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry; Concept of conduction and film	Yunus A. Cengel & Afsin J. Ghajar, Heat & Mass Transfer, Chapter 3.	International Standard: https://ocw.mit.edu/courses/2-051-introduction-to-heat-transfer-fall-2015/pages/syllabus/	6	1. Determination of thermal conductivity of an insulating powder/or an insulating plate.

		resistances; Critical insulation thickness; Lumped system approximation and Biot number; Heat transfer through pin fins; 2D conduction solutions for steady and unsteady heat transfer. Transient heat conduction in 1D; conduction with moving boundary.	Domkundwar Arora Domkundwar , A Course in Heat & Mass Transfer, Chapter-2, Chapter-4, Chapter-5, Chapter-6	AICTE-prescribed syllabus: https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf https://che.iith.ac.in/assets/acad/btechcourses.pdf https://www.iitbbs.ac.in/mtech-thermal-science-and-engineering.php Industry Mapping: MATLAB, ANSYS		2. Heat conduction analysis of a solid cylinder using ANSYS
3	Convection on Heat Transfer	Basic equations; Boundary layers; Forced convection; External and internal flows; Natural convective heat transfer; Dimensionless parameters for forced and free convection and heat transfer; Correlations for forced and free convection; Approximate solutions to laminar boundary layer equations for internal and external flow; Estimating heat transfer rates in	D.S. Kumar, Heat & Mass Transfer, Chapter 11 & Chapter 12	International Standard: https://ocw.mit.edu/courses/2-051-introduction-to-heat-transfer-fall-2015/pages/syllabus/ AICTE-Prescribed Syllabus: https://www.aicte-india.org/downloads/Model_Syllabi_For_Ug_%20mech_%20engg.Pdf https://www.iitmandi.ac.in/Pdf/Senate_Courses/Me303.Pdf https://www.iitbbs.ac.in/Mtech-Thermal-Science-And-Engineering.Php Industry Mapping: ANSYS	8	1. Simulating Thermal Pipe Flows using ANSYS 2. Simulating heat transfer over a flat plate using ANSYS 3. Determination of the convective heat transfer coefficient for flow over a heated plate. 4. Determine the overall heat transfer coefficient at the

		laminar and turbulent flow situations using appropriate correlations for free and forced convection; Turbulent flow in pipes; Flow over bank of tubes; heat transfer for impinging jets.			surface of a given metal pipe by the forced convection method. 5. To determine the overall heat transfer coefficient at the surface of a given vertical metal cylinder by the natural convection method.
4	Radiation Heat Transfer	Interaction of radiation with materials; Definitions of radiative properties; Stefan Boltzmann's law; Black and grey body radiation; Calculation of radiation heat transfer between surfaces using radiative properties; View factors and the radiosity method; Examples for two-body enclosures; Radiation shield.	Yunus A. Cengel & Afsin J. Ghajar, Heat & Mass Transfer, Chapter 12 & Chapter 13.	8 <i>International Standard:</i> https://ocw.mit.edu/courses/2-051-introduction-to-heat-transfer-fall-2015/pages/syllabus/ <i>AICTE-prescribed syllabus:</i> https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf https://www.iitmandi.ac.in/pdf/senate_courses/ME303.pdf <i>Industry Mapping: MATLAB, ANSYS</i>	1. Determination of the emissivity of a given sample. 2. Modelling Radiative heat transfer using ANSYS 3. Calculates view factors and radiative heat transfers between two surfaces using MATLAB
5	Heat Exchange	Function, classification and configuration of heat	Yunus A. Cengel & Afsin J. Ghajar, "Heat & Mass	3 <i>International Standard:</i> https://ocw.mit.edu/courses/2-051-introduction-to-heat-transfer-fall-2015/pages/syllabus/	1. Calculate the outlet temperature for a

er Design	exchangers; overall heat transfer coefficient; concept of fouling factor; Evaluation of mean temperature difference; Heat exchanger effectiveness; Analysis, design and selection of heat exchangers.	Transfer", Chapter 11.	<u>transfer-full-2015/pages/syllabus/</u> AICTE-prescribed syllabus: <u>https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf</u> <u>https://www.iitmandi.ac.in/pdf/senate_courses/ME303.pdf</u> Industry Mapping: MATLAB	heat exchanger with ε-NTU method using MATLAB 2. Study of a shell and tube heat exchanger and determination of LMTD.
6 Boiling and Condensation heat transfer	Pool boiling; Saturated pool boiling curve; Flow boiling; Rohsenow's nucleate boiling correlation; critical heat flux correlation; minimum heat flux and film boiling correlations. Film and drop wise condensation dew point.	Yunus A. Cengel & Afsin J. Ghajar, Heat & Mass Transfer, Chapter 10.	3 International Standard: <u>https://ocw.mit.edu/courses/2-051-introduction-to-heat-transfer-fall-2015/pages/syllabus/</u> AICTE-prescribed syllabus: <u>https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf</u> <u>https://www.iitk.ac.in/me/ME341</u> Industry Mapping: MATLAB	1. Calculate the outlet temperature of a condenser with ε-NTU method using Matlab
7 Introduction to mass transfer	Analogy between heat and mass transfer; Mass diffusion; mass diffusion without and with homogeneous chemical reactions;	Yunus A. Cengel & Afsin J. Ghajar, Heat & Mass Transfer, Chapter 14.	3 International Standard: <u>https://ocw.mit.edu/courses/2-051-introduction-to-heat-transfer-fall-2015/pages/syllabus/</u> Industry Mapping: MATLAB	1. Estimate the rate of diffusion of a gas by implementing Fick's law of diffusion in Matlab

	boundary and initial conditions; Fick's Law; Steady and transient mass diffusion; Simultaneous heat and mass transfer.		AICTE-prescribed syllabus: https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf https://iitr.ac.in/Departments/Mechanical%20and%20Industrial%20Engineering%20Department/static/Academics/Syllabus/BTech_Mech.pdf Industry Mapping: MATLAB	
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TEXT BOOK:

1. Yunus A. Cengel & Afsin J. Ghajar, Heat & Mass Transfer, McGraw Hill Education (India) Private Limited, 2014.
2. Domkundwar Arora Domkundwar, A Course in Heat & Mass Transfer, Dhanpat Rai & Co, 2017
3. D.S. Kumar, Heat & Mass Transfer, S.K. Kataria & Sons, 2015

REFERENCE BOOKS:

4. J.P. Holman and S. Bhattacharyya, "Heat Transfer," McGraw Hill, 2017.
5. F.P. Incropera, and D.P. Dewitt, "Fundamentals of Heat and Mass Transfer," John Wiley, 2019.
6. Massoud Kaviany, "Principles of Heat Transfer," John Wiley, 2002.
7. Bejan, "Heat Transfer," John Wiley, 1993
8. P.S. Ghoshdastidar, Heat Transfer, Oxford University Press, 2012

ONLINE RESOURCES: MIT OPEN COURSEWARE

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Subject Name: Machine Element & System Design

Credit: 4

Subject Code: PCCME502

Lecture Hours: 48

Pre-requisite: Engineering Mechanics, Mechanics of Deformable solid,

Relevant Links: STUDY MATERIALS

Module No.	Topic	Sub-topics	Text Books and Chapters	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	Introduction	Anatomy of machines; Functional dissection machines into machine elements including gears, rack and pinions, cams, chains, belts, pulleys, flywheels, bearings, shafts, keys, brakes, etc.; Engineering materials; Design considerations – Limits, fits and standardization; Friction and lubrication.	Design of Machine Elements, V.B.Bhandari - Chapter 2 A Textbook of Machine Design, Khurmi & Gupta – Chapter 3	AICTE prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Financial_Mechanical%20Engg.pdf International Standards : https://ocw.mit.edu/courses/2-72-elements-of-mechanical-design-spring-2009/pages/readings/ Industry Mapping: AutoCAD https://www.autodesk.in/products/autocad/	6	Making 2D drawings for some simple machine elements

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2	Failure Theories	Static failure theories including normal stress theory, shear stress theory, distortion energy theory; von Mises stress; Factor of safety; Stress concentration factors; Fatigue failure theories: mean and alternating stresses, yield, ultimate, and endurance strength; Goodman, Gerber, and Soderberg lines.	Design of Machine Elements, V.B.Bhandari - Chapter 4, 5	AICTE prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Financial_Mechanical%20Engg.pdf International Standards : https://ocw.mit.edu/courses/2-72-elements-of-mechanical-design-spring-2009/pages/readings/ https://biomechanics.stanford.edu/mechanical-systems-design Industry Mapping: ANSYS https://www.ansys.com/en-in/academic/students	10	Applying theories of failures in finite element analysis using ANSYS Mechanical
3	Force analysis of machine elements	Force analysis of machine elements and machine systems; Application to power screws, couplings and brakes.	Design of Machine Elements, V.B.Bhandari - Chapter 6,9 A Textbook of Machine Design, Khurmi & Gupta - Chapter 25	AICTE prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Financial_Mechanical%20Engg.pdf International Standards : https://ocw.mit.edu/courses/2-72-elements-of-mechanical-design-spring-2009/pages/readings/ https://biomechanics.stanford.edu/mechanical-systems-design Industry Mapping: ANSYS https://www.ansys.com/en-in/academic/students	8	Force and strength analysis of power screws, couplings etc. using ANSYS Mechanical

4	Design of Machine Elements	<i>Springs</i> – Helical compression, tension, torsional and leaf springs; <i>Fasteners</i> – threaded fasteners, bolted joints, preloaded bolts, rivets and welded joints; <i>Shafts</i> – shafts under static and fatigue loadings; Keys; Sliding and rolling contact bearings; <i>Transmission elements</i> – transmission ratio and efficiency of spur, helical, bevel and worm gears; clutches; belt and chain drives; Flywheels.	Design of Machine Elements, V.B.Bhandari - Chapter 8, 9, 10, 13, 15, 16, 17, 21	AICTE prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Financial_Mechanical%20Engg.pdf International Standards : https://ocw.mit.edu/courses/2-72-elements-of-mechanical-design-spring-2009/pages/readings/ https://biomechanics.stanford.edu/mechanical-systems-design Industry Mapping: CREO, Solidworks, ANSYS https://www.ptc.com/en/products/creo https://www.solidworks.com/product/solidworks-3d-cad https://www.ansys.com/en-in/academic/students	18	1. 3D Modelling of machine elements using Solidworks/Creo with the calculated dimensions 2. Checking the safety of the elements by importing the 3D models to ANSYS Mechanical and carrying out Finite Element Analysis
5	Mechanical Systems	Case studies on automobile suspensions, automatic transmissions, material conveyor systems, construction machinery, etc.	Machine Design: An Integrated Approach, Robert L. Norton – Chapter 10	AICTE prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Financial_Mechanical%20Engg.pdf International Standards : https://ocw.mit.edu/courses/2-72-elements-of-mechanical-design-spring-2009/pages/readings/ https://biomechanics.stanford.edu/mechanical-systems-design Industry Mapping: CREO, Solidworks https://www.ptc.com/en/products/creo https://www.solidworks.com/product/solidworks-3d-cad	6	3D modelling of different components of a machine and carrying out the assembly in Creo / Solidworks

Course Outcomes:

After completing this course,

1. They can understand the design specifications with codes & standard, component behaviour subjected to static & dynamic* loads and identify the concepts of principal stresses, the failure criteria.
2. They can understand the design of different mechanical joints
3. They can understand the design of shaft, coupling & transmission elements like gear, chain, belt pulley drives.
4. They can analyse the pressure distribution and design of power screw, springs, bearings, brakes, clutches and engine parts.

Learning Resources:

Text Books

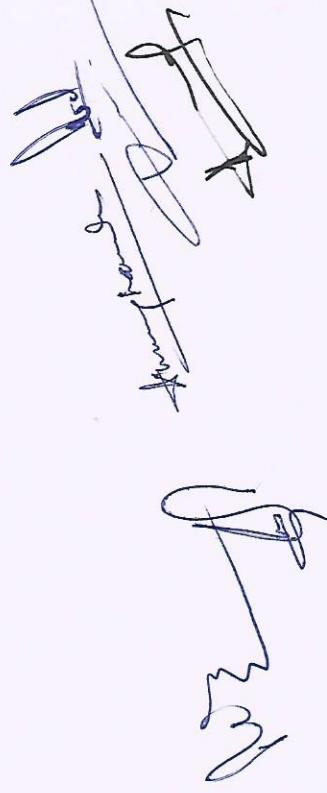
1. V. B. Bhandari, Design of Machine Elements by, McGraw Hill Publishing Co. Ltd.
2. R. L. Norton, Mechanical Design– An Integrated Approach, Prentice Hall
3. A Textbook of Machine Design, Khurmi & Gupta, S Chand Publication

Reference Books

1. J.E. Shigley and C.R. Mischke, Mechanical Engineering Design, 5th Edition, McGraw Hill International, 1989.
2. D. Deutschman, W.J. Michels and C.E. Wilson, Machine Design Theory and Practice, Macmillan, 1992.
4. R.C. Juvinat, Fundamentals of Machine Component Design, John Wiley, 1994.
5. M.F. Spottes, Design of Machine elements, Prentice-Hall India, 1994.
6. R. L. Norton, Mechanical Design– An Integrated Approach, Prentice Hall, 1998.
7. P. Kanniah, Machine Design, 2nd Edition, Scitech Publications.

Online Learning Materials:

1. Coursera: <https://www.coursera.org/learn/machine-design1>
2. NPTEL: <https://archive.nptel.ac.in/courses/112/105/112105124/>



Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
Institute of Engineering & Management, Jaipur

Subject Name: Manufacturing Process II

Credit: 3

Lecture Hours: 38

Subject Code: PCCME503

Pre-Requisites: Manufacturing Processes I

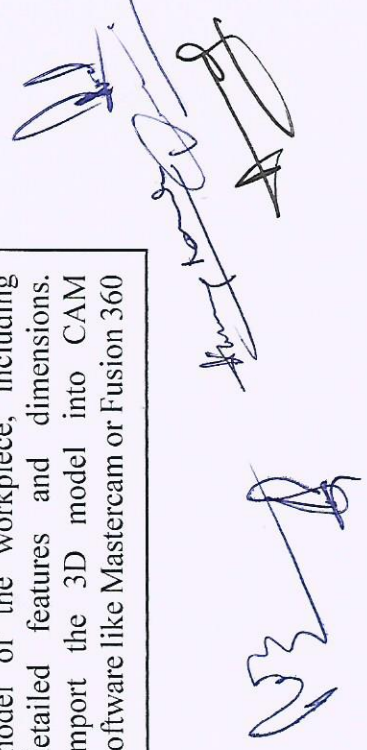
Relevant Links: Study Material

Course Objectives:

To impart knowledge to make students able to demonstrate the conventional and unconventional tooling needed for manufacturing and assembly of different components. Also, students will be able to understand the principles of working with NC, CNC machine tools, and rapid prototyping.

Course Contents:

Module No.	Topic & Sub-topics	Textbook & Chapters	Mapping with Industry and International Academia	Contact Hrs	Corresponding Lab Assignment
1	Machine tool Turning, Drilling, Milling, Grinding, and other finishing processes; Single and	Manufacturing Processes for Engineering Materials- 6 th edition- S Kalpakjian &	International Academia: https://ocw.mit.edu/courses/2-670-mechanical-engineering-tools-january-iap-2004/pages/syllabus/	8	Utilize CAD software such as SolidWorks or CATIA to create a 3D model of the workpiece, including detailed features and dimensions. Import the 3D model into CAM software like Mastercam or Fusion 360



	multi-point cutting tools; Cutting tool materials; Cutting fluids; Material removal rates, surface finish, accuracy, and integrity, and machinability	S R Schmid-Chapter 8	AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf Industry Mapping: MATLAB, ANSYS, Python	CAM to generate toolpaths for each machining operation. Conduct experiments or simulations to compare the effects of different cutting tools, materials, and machining parameters on material removal rates, surface finish, accuracy, integrity, and machinability. 3. Study of 3D Machining using virtual labs. https://fab-coep.vlabs.ac.in/exp/3d-machining/theory.html
2	Unconventional Manufacturing Processes: Abrasive Jet Machining, Water Jet Machining, Ultrasonic Machining, Electrical Discharge Machining, Wire EDM; Electro-Chemical Machining; Laser Beam Machining, Plasma Arc Machining, Electron Beam Machining; Micro and nanomanufacturing.	Manufacturing Science, 2nd edition- Amitabha Ghosh & Asok Kumar Mallik, Chapter-6	International Academia: https://ocw.mit.edu/courses/2-008-design-and-manufacturing-ii-spring-2004/pages/lecture-notes/ AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf Industry Mapping: Minitab, Ansys	Utilize simulation software like ANSYS Simulate material removal rate, surface finish, accuracy, tool wear, and energy consumption using appropriate parameters and materials. Select a specific application or component suitable for micro or nanomanufacturing, considering factors such as size, complexity, and material properties. Utilize CAD software such as SolidWorks or CATIA to design the micro or nanocomponent, ensuring precise dimensions and features. Study the effect of process parameters in electrochemical grinding.

					https://mm-coep.vlabs.ac.in/exp/electrochemical-grinding/theory.html
5	CNC Machine Tools Structure and working principle of CNC lathe, milling machine, Examples and use of CNC machines, Machining Centre (Vertical and Horizontal), Components and Their Functions in NC/CNC Machines MCU, DPU, and CLU, Feed drives using stepper/ servo motors and recirculating ball screw-nut system, Automatic Tool Changers- Tool Turret and Tool Magazine, Automatic pallet Changer.	P.N. Rao, CAD/CAM Principles and Application, Chapter 9, 10, 11, 12	International Academia: https://ocw.mit.edu/courses/2-008-design-and-manufacturing-ii-spring-2003/resources/labs13/ AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf Industry Mapping: Fusion 360, Solidworks, NX 8, MasterCAM	6	Introduce industry-standard CAD/CAM software such as Mastercam or Fusion 360 CAM for CNC programming. Demonstrate the process of designing and programming a simple part for machining on a CNC lathe or milling machine using the selected software. Validate the CNC programs by simulating the machining operations in the CAM software and analyzing the toolpaths and simulated results. Introduce simulation software such as Siemens NX or Autodesk HSMWorks for virtual modeling and analysis of CNC machine components and functions. Explore the operation and optimization of automatic tool changers (ATC) such as tool turrets and tool magazines through virtual simulations. Study of Computer Controlled Cutting of wooden object. https://fab-coep.vlabs.ac.in/exp/computer-controlled-cutting/theory.html

6	Basic systems of NC and CNC machines Coordinate system, Control– open loop and closed loop, Dimensioning– absolute and incremental, Point–to–point and contour motion, Linear and circular Interpolation. Part Programming for CNC machines Manual Part Programming using ISO G and M Codes in CNC lathe and milling machine for simple jobs, Canned cycle. Computer Aided Part Programming using MACRO statements in APT for simple jobs in CNC lathes and milling machines.	P.N. Rao, CAD/CAM Principles and Application, Chapter 13, 14, 15	International Academia: https://ocw.mit.edu/courses/2-008-design-and-manufacturing-ii-spring-2003/resources/labs13/ AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf Industry Mapping: Fanuc CNC simulator, SIEMENS Sinutrain Software	7
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7	Additive Manufacturing Processes: Extrusion; vat polymerization, powder bed fusion; material jetting, binder jetting; direct energy deposition and lamination processes.	Principles of Modern Manufacturing, Mikell P Groover, Part VIII, Chapter 29	International Academia: https://professional.mit.edu/course-catalog/additive-manufacturing-3d-printing-factory-floor AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf Industry Mapping: Solidworks, CURA, ThinkerCAD	6	1. Utilize CAD software such as SolidWorks or Autodesk Fusion 360 to design the component, ensuring adherence to additive manufacturing design guidelines. 2. Use simulation software tools such as Materialise Magics or Ultimaker Cura to optimize the design and printing parameters for the selected additive manufacturing process. Optimize process parameters such as layer thickness, build orientation, infill density, and support structures to achieve desired outcomes such as part strength, dimensional accuracy, and surface finish. 3. Simulation of Pre-processing in Additive manufacturing. https://3dp-dei.vlabs.ac.in/exp/simulation-additive-manufacturing/index.html Simulation of Powder Binding / Jetting Process. https://3dp-dei.vlabs.ac.in/exp/simulation-powder-binding/theory.html
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Course Outcomes:

1. Gain an understanding of conventional and unconventional machines and associated tools utilized in the manufacturing of diverse components.
2. Comprehend the design and assembly principles of molds and dies within manufacturing processes.
3. Develop proficiency in CNC machine tools operation and programming techniques.
4. Acquire knowledge of additive manufacturing processes and their applications in modern manufacturing.

Learning Resources:

Text Book

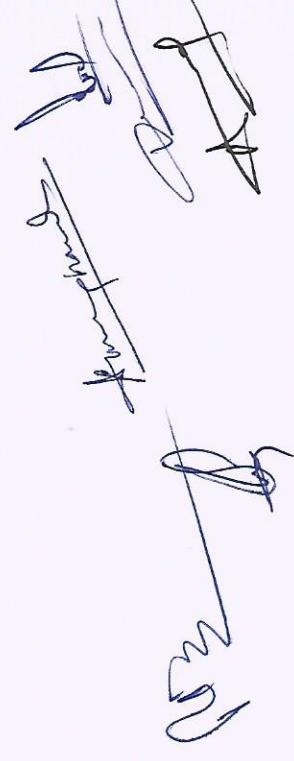
1. S. Kalpakjian and S.R. Schmid, Manufacturing Processes for Engineering Materials, 5th Edition, Pearson India, 2014.
2. P.N. Rao, CAD/CAM Principles and Application, McGraw Hill, 2009.
3. M.P. Grover, Fundamentals of Modern Manufacturing, 3rd Edition, Wiley.

Reference Book

4. R.K. Jain, Engineering Metrology, 21st Edition, Khanna Publication, New Delhi, 1984.
5. Y. Koren, Computer Control of Manufacturing Systems, McGraw Hill, 1986.
6. M.P. Groover, Automation, Production Systems and CIM, Prentice Hall.
7. A. Ghosh & A.K. Mullick, Manufacturing Science, EW Press.
8. A. Ghosh, Rapid Prototyping, EW Press.

Online Learning Resources:

1. <https://ocw.mit.edu/courses/2-008-design-and-manufacturing-ii-spring-2004/pages/labs/>
2. <https://www.coursera.org/specializations/3d-printing-additive-manufacturing>
3. https://onlinecourses.nptel.ac.in/noc21_me04/preview
4. <https://www.coursera.org/specializations/autodesk-cad-cam-manufacturing>
5. <https://www.coursera.org/specializations/cad-design-digital-manufacturing>



Subject Name: Mechatronics, Robotics & Control

Credit: 2

Subject Code: PCCME504

Lecture Hours: 24

Pre-requisite: Kinematics of Machines, Mathematics

Relevant Links: STUDY MATERIAL

NPTEL

COURSE OBJECTIVES:

1. Model and analyze mechatronic systems for an engineering application.
2. Identify sensors, transducers and actuators to monitor and control a process or product.
3. Develop PLC programs for an engineering application.
4. Evaluate the performance of mechatronic systems.

COURSE OUTCOMES:

- CO1:** Students will have developed an ability to recognize and analyze electro-mechanical systems in daily lives.
CO2: Students can understand the role of sensors, actuators, and controls in mechatronic systems.
CO3: They will be able to understand the basic theory of robot kinematics.
CO4: They will be familiar with control theory and controller design.
CO5: Students will appreciate and perform measurement of various quantities using instruments, their accuracy & range, and the techniques for controlling devices automatically.

Module number	Topic	Sub-topics	Textbook & Chapter No.	Mapping with Industry and International Academia	Lecture Hours	Corresponding Assignment
1	Introduction	Electro-mechanical systems; Typical applications; Examples – automobiles, home appliances, medical instruments, etc.	W. Bolton, "Mechatronics," Addison Wesley Longman, 2010. [Chapter 1]	International Standard: (https://ocw.mit.edu/courses/2-12-introduction-to-robotics-fall-2005/pages/syllabus/) AICTE-prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf) Industry Mapping: MATLAB	2	1. List various mechanical systems used in practical life, which can be replaced by more efficient electro-mechanical systems and explain how the transformation can be incorporated.
2	Sensors	Transduction principles; Sensitivity, accuracy, range, resolution, noise sources; Sensors for common engineering measurements – proximity, force, velocity, temperature, etc.; Signal processing and conditioning; Selection of sensors.	W. Bolton, "Mechatronics," Addison Wesley Longman, 2010. [Chapter 2]	International Standard: (https://ocw.mit.edu/courses/2-12-introduction-to-robotics-fall-2005/pages/syllabus/) AICTE-prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf)	4	1. Conduct a review of literature on the development of proximity sensors.

3	Actuators	Pneumatic and hydraulic actuators; Electric motors including DC, AC, BLDC, servo and stepper motors; Solenoids and relays; Active materials – piezoelectric and shape memory alloys.	W. Bolton, "Mechatronics," Addison Wesley Longman, 2010. [Chapters 2, 7, 9]	m/Final_Mechanical%20Engg.pdf) Industry Mapping: MATLAB International Standard: (https://ocw.mit.edu/courses/2-12-introduction-to-robotics-fall-2005/pages/syllabus/) AICTE-prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf)	4	1. Model and simulate a piezoelectric system using MATLAB Simulink.
4	Machine Controls	Microprocessors and their architecture; Memory and peripheral interfacing; Programming; Microcontrollers; Programmable Logic Controllers; principle and operation; Analog and digital input/output modules; Memory module; Timers, internal relays,	W. Bolton, "Mechatronics," Addison Wesley Longman, 2010. [Chapters 10, 14]	Industry Mapping: MATLAB International Standard: (https://ocw.mit.edu/courses/2-12-introduction-to-robotics-fall-2005/pages/syllabus/) AICTE-prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf)	4	1. Write a MATLAB script to control the blinking of an LED connected to a microcontroller (e.g., Arduino). Use MATLAB's Arduino support package to send commands to the microcontroller to turn the LED on and off at specific

		counters and data handling; Industrial automation systems; PLC programming; Industry kits (Arduino, Raspberry Pi, etc.).		m/Final_Mechanical%20Engg.pdf)	intervals.
5	Robotics	Robot configurations: serial and parallel; Denavit–Hartenberg parameters; Manipulators kinematics; Rotation matrix, Homogenous transformation matrix; Direct and inverse. Kinematics for robot position and orientation; Workspace estimation and path planning; Robot vision; Motion tracking; Robot programming and control; Industrial robots - Pick and place robots, sorting, assembly, welding, inspection, etc.	J. J. Craig, Introduction to Robotics Mechanics and Control, Addison Wesley, 1999. [Chapters 1, 2, 3, 4]	Industry Mapping: MATLAB International Standard: (https://ocw.mit.edu/courses/2-12-introduction-to-robotics-fall-2005/pages/syllabus/) AICTE-prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf)	4

		response, frequency response; Root Locus method and Bode plots.		AICTE-prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf) Industry Mapping: MATLAB		transfer functions and analyze the system's stability and performance characteristics using MATLAB.
7	Computational Tools	Demonstration and projects using simulation software (e.g., Matlab) for control systems and robotics.	J. J. Craig, Introduction to Robotics Mechanics and Control, Addison Wesley, 1999. [Chapters 1, 2, 3, 4] AICTE-prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf) Industry Mapping: MATLAB	2	1.	Model a hydraulic actuator system using Simscape Fluids. Include components such as a hydraulic pump, hydraulic cylinder, valves, and fluid lines to simulate the actuator's movement driven by hydraulic pressure. Investigate how changes in fluid properties, valve settings, or load conditions affect the actuator's performance.

TEXT BOOK:

1. W. Bolton, "Mechatronics," Addison Wesley Longman, 2010.
2. J. J. Craig, Introduction to Robotics Mechanics and Control, Addison Wesley, 1999.

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Subject Name: Advanced welding Technology

Credit: 3

Lecture Hours: 36

Subject Code: Manufacturing Process I

COURSE OBJECTIVES:

- To make the students learn basic set-up configurations of precision welding equipment and their applications.
- To develop the skills needed to weld ferrous and non-ferrous metals.
- Illuminate the concepts of continuity, mechanism, physics, and design elements in welding process
- Comprehend the characteristics of weldable materials and welding technologies
- Demonstrate the importance of modelling and simulation of welding process
- Develop intellectual skills for correlating the microstructural evolution with the defects and properties of weldments

RELEVANT LINK: Course Material

NPTEL

Module No.	Topic & Sub-topics	TextBook & Chapter	Mapping with Industry and International Academia	Content Hrs.	Corresponding Lab Assignment
1	Overview of welding processes and their classification, types of joints,	O P Khanna Welding Technology,	International Academia: https://ocw.aprende.org/courses/materials-science-and-	12	1. Simulate precision welding processes using the

edge preparation, weld symbols, weld nomenclature, bead geometry, power density, heat sources – Gaussian distribution of heat flux, welding techniques – linear and orbital. Arc characteristics. Voltage-current characteristics. Types of welding manipulators and their applications. Arc Welding- SAW, TIG, MIG Different types of equipment, Power sources, Choice of Polarity, Arc characteristics, Modes of Metal Transfer, Welding Positions, Electrode selection. Resistance Welding processes- Spot, Butt, Seam, Projection. Solid State Welding processes- Forge, Friction, Friction Stir, Diffusion, and Roll welding. Critical and Precision Welding processes- USW, PAW, LBW, EBW, hybrid welding. Underwater Welding-	Chapter 4, 5, 6, 8	<u>engineering/3-37-welding-and-joining-processes-fall-2002/index.htm</u> AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/MModel_Curriculum/Final_Mechanical%20Engg.pdf https://www.aicte-india.org/sites/default/files/MModel_Curriculum/Final_Mechanical_Engg.pdf Industry Mapping: MATLAB, ANSYS, Python	selected software, considering factors such as welding parameters, material properties, and joint geometry. Optimize welding parameters such as voltage, current, wire feed rate, travel speed, and shielding gas composition to achieve desired weld quality, including bead geometry, and penetration, and distortion. 2. Introduce virtual reality (VR) welding simulation technology, including its benefits for training and skill development in welding.
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	Wet Welding and Dry Welding: Hyperbaric and Cavity. Welding of Plastics- Hot Gas Welding, Hot Tool Welding, Hot Press Welding, Friction Welding, Ultrasonic Welding. Case studies and applications – industrial, automotive and aerospace.				
2	Thermal modeling and simulation of welding processes – governing heat transfer equations and boundary conditions for various types of welding processes. Estimation of cooling rates. Prediction of mechanical properties, micro/macrosstructures of weldments and heat-affected zone. Prediction of weld defects such a crack, segregation, lack of fusion. Modeling and simulation of pulsed arc processes. Solidification behaviour of fusion weld: structural zones, epitaxial	R.S. Parmar "Welding Engineering and Technology" Chapter 2	International Academia: IIT Syllabus: https://www.iitg.ac.in/mech/docs/94/ME675.pdf AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical_Engg.pdf Industry Mapping: MATLAB, ANSYS, Python	10	1. Provide an overview of industry-relevant software tools for thermal simulation of welding processes, such as ANSYS Welding Simulation or Simufact Welding. 2. Predict mechanical properties, micro/macrosstructures of weldments, and heat-affected zone using thermal simulation outputs, such as temperature gradients and cooling rates.

	growth, weld pool shape and columnar grain structures.				
3	Welding Metallurgy, HAZ, Effect of different process parameters on the characteristics of weldment. Weldability of Plain Carbon Steel, Stainless Steel, Cast Iron, Aluminium copper, nickel and titanium alloys. Microstructures of weldment. Impact of micro/ macro-structures and segregation on mechanical properties. Pre – and post-treatment. Effects of heat flow on residual stresses and distortion. Weldability tests. Welding defects – causes and remedies. Methods of testing weldments – mechanical, pressure and leak testing. Inspection methods – visual, penetrant, magnetic, ultrasonic, x-ray and gamma radiography. Use of imaging techniques for online monitoring.	R.S. Parmar "Welding Engineering and Technology" Chapter 8, 9, 10	International Academia: IIT Syllabus: https://www.iitg.ac.in/mech/documents/94/ME675.pdf AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical_Engg.pdf Industry Mapping: MATLAB, ANSYS, Python	8	1. Analyze the weldability of plain carbon steel, stainless steel, cast iron, aluminum, copper, nickel, and titanium alloys using simulation results and metallurgical data. 2. Conduct simulations or virtual inspections of weldments using software tools to identify potential defects and evaluate inspection methods.

4	Welding Fixtures, Welding Automation and Robotic Welding, welding sensors and data acquisition; welding process modeling and optimization;	O P Khanna Welding Technology, Chapter 34, 45, 46	International Academia: IIT Syllabus: https://www.iitg.ac.in/mech/documents/94/ME675.pdf AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Mechanical%20Engg.pdf https://www.aicte-india.org/sites/default/files/Mechanical_Curriculum/Final_Mechanical_Engg.pdf Industry Mapping: MATLAB, ANSYS, Python	6	1. Provide an overview of software tools commonly used for robotic welding cell design and optimization, such as RoboDK or Process Simulate. 2. Demonstrate the setup and simulation of robotic welding cells, including robot programming, workpiece positioning, and welding process parameters.
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COURSE OUTCOMES:

- CO1: Understand principles and characteristics of different critical and precision welding processes, joint configurations, and heat source characteristics
- CO2: Apply the knowledge of power sources, formulate governing equations and boundary conditions to simulate the thermal phenomenon in the course of a welding process
- CO3: Assess the weldability of different materials, including plain carbon steel, stainless steel, cast iron, and aluminium alloys, based on their metallurgical properties and behaviour during welding.
- CO4: Identify common welding defects, understand their causes and remedies, and select appropriate inspection and testing methods for welded joints.

Textbooks/References:

Textbook(s):

1. Dr. R.S. Parmer "Welding Engineering and Technology" Khanna Publishers.
2. O P Khanna "A Text Book of Welding Technology"

Reference(s):

3. American Welding Society, Welding Handbook - Welding Processes Part 2, Vol. 3, AWS, 2004.
4. ASM International Handbook Committee, Welding, Brazing and Soldering, ASM handbook, Vol 6, 1993.
5. Y. N. Zhou, Microjoining and Nanojoining, Woodhead publishing, 2008.
6. L. Liu, Welding and Joining of Magnesium Alloys, Woodhead Publishing, 2010.
7. J. Norrish, Advanced welding Processes, Woodhead Publishing Limited 2007.
8. L. E Lindgren, Computational welding mechanics, Woodhead Publishing Limited 2007.
9. J. A. Goldak, Computational welding mechanics, Springer, 2005
10. H. S. Bawa "Manufacturing Technology-I" Tata Me Graw Hill Publishers New Delhi, 2007.
11. S. V. Nadkarni, Modern Arc Welding Technology, Oxford & IBH Publishing Co. Pvt. Ltd.
12. CORNU.J. Advanced welding systems – Volumes I, II and III, JAICO Publishers, 1994.
13. LANCASTER.J.F. – Metallurgy of welding – George Alien & Unwin Publishers, 1980
14. Carry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2002
15. P.L. Jain "Principles of foundry Technology" Tata Mc Graw Hill Publishers.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc20_me65/preview
2. https://onlinecourses.nptel.ac.in/noc21_me99/preview

Dr. R. S. Parmer
O. P. Khanna
J. Norrish
L. E. Lindgren
J. A. Goldak
H. S. Bawa
S. V. Nadkarni
Cornu J.
Lancaster J. F.
Carry B.
P. L. Jain

Subject Name: Power Plant Engineering
Subject Code: PECME501D
Pre-requisite: Engineering Thermodynamics
Credit: 3
Lecture Hours: 36

Relevant Links: NPTEL

COURSE OBJECTIVES:

The purpose of learning this course is to provide an overview of power plants and the associated energy conversion issues

COURSE OUTCOMES:

At the end of this course students will demonstrate the ability to

1. To understand the principles of operation for steam and gas thermal power plants.
2. To understand the principles of operation for hydro power plants and nuclear power plants.
3. To understand the principles of operation for solar, wind and geothermal energy power plants.
4. To understand the economics of power generation and the environmental aspect of power generation.

Module number	Topic	Sub-topics	Textbook and chapter	Mapping with International Academia	Lecture Hours	Corresponding Assignment
1	Introduction	Power plants – types and classification based on energy sources. Fundamentals of	Nag P.K., Power Plant Engineering,	International Standard: https://ocw.mit.edu/courses/2-60j-fundamentals-of-advanced-	5	1. Using Matlab, develop a code to calculate the gross power

	thermodynamics, chemistry, and transport applied to energy systems.	3rd ed., chapter 1.	energy-conversion-syllabus/2020/pages/syllabus/https://www.uprm.edu/inme/wp-content/uploads/sites/96/2019/03/INME-4027-Power-Plant-Engineering.pdf AICTE-prescribed syllabus: https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf	generation for a given power plant, provided the fuel and air flow rate.
2	Coal based Thermal Power Plants	Nag P.K., Power Engineering, 3rd ed. Chapter 2 and chapter 3.	Industry Mapping: MATLAB International Standard: https://ocw.mit.edu/courses/2-60j-fundamentals-of-advanced-energy-conversion-spring-2020/pages/syllabus/ https://webapp4.asu.edu/books/tore/viewsyllabus/2207/81395 AICTE-prescribed syllabus: https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf Industry Mapping: MATLAB	1. Using Matlab, develop a code to calculate efficiency and power output of a steam power plant operated on reheat regenerative Rankine cycle with closed cycle feedwater heater. Plot the changes in power output and efficiency for parametric

3	Gas Turbine and Combined Cycle Power Plants	Brayton cycle analysis and optimization; Components of gas turbine power plants; Combined cycle power plants; Synthetic fuels; Integrated gasification combined cycle.	Nag P.K., Power Plant Engineering, 3rd ed., chapter 11.	International Standard: https://ocw.mit.edu/courses/2-60j-fundamentals-of-advanced-energy-conversion-spring-2020/pages/syllabus/ https://webapp4.asu.edu/books/tore/viewsyllabus/2207/81395 AICTE-prescribed syllabus: https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf Industry Mapping: MATLAB	5	variation of regenerator effectiveness.
4	Nuclear Power Plants	Basics of nuclear energy conversion; Reactor heat generation; Thermal design principles; Layout and subsystems of nuclear power plants; Boiling Water Reactor (BWR); Pressurized Water Reactor (PWR); CANDU Reactor; Pressurized Heavy Water Reactor (PHWR); Fast Breeder Reactors (FBR); Gas	Nag P.K., Power Plant Engineering, 3rd ed., chapter 9.	International Standard: https://ocw.mit.edu/courses/22-312-engineering-of-nuclear-reactors-fall-2015/pages/syllabus/ AICTE-prescribed syllabus: https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf Industry Mapping: MATLAB	5	1. Develop a steady-state control program for a nuclear reactor using Matlab/SIMULINK.

		cooled and liquid metal cooled reactors; Safety measures for nuclear power plants.				
5	Hydroelectric Power Plants	Classification; Typical layout and components. Hydroelectric power; Pumped storage.	Nag P.K., Power Plant Engineering, 3rd ed., chapter 10.	International Standard: https://ocw.mit.edu/courses/2-60j-fundamentals-of-advanced-energy-conversion-spring-2020/pages/syllabus/ https://webapp4.asu.edu/books/tore/viewsyllabus/2207/81395 AICTE-prescribed syllabus: https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf Industry Mapping: MATLAB	5	1. Develop a generalized model to simulate a hydro power plant using MATLAB/SIMULINK
6	Renewable Power Systems	Principles of wind, tidal, solar photo-voltaic, solar thermal, geothermal, biogas and fuel cell power systems. Ocean power: thermal and wave. Ocean power: tidal and current.	Nag P.K., Power Plant Engineering, 3rd ed., chapter 14.	International Standard: https://ocw.mit.edu/courses/2-60j-fundamentals-of-advanced-energy-conversion-spring-2020/pages/syllabus/ https://webapp4.asu.edu/books/tore/viewsyllabus/2207/81395 AICTE-prescribed syllabus: https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf	5	1. Using MATLAB, develop a code to calculate the efficiency of a wind power plant.

7	Energy Economics and Environment	Economic and environmental issues; Power tariffs; Load distribution parameters; Load curve; Capital and operating cost of different power plants; Pollution control technologies including waste disposal options for coal and nuclear plants.	Domkundwar and Domkundwar, Power plant engineering, eighth ed., Dhanpat Rai and Co, 2016. Chapter 35, 39.	Industry Mapping: MATLAB International Standard: https://ocw.mit.edu/courses/2-60j-fundamentals-of-advanced-energy-conversion-spring-2020/pages/syllabus/ AICTE-prescribed syllabus: https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Enng.pdf Industry Mapping: MATLAB	5	1. Using MATLAB/SIMULINK, perform the load flow analysis of a series of thermal powered plants and minimize the power tariff.
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TEXT BOOK:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. Domkundwar and Domkundwar, Power plant engineering, eighth ed., Dhanpat Rai and Co, 2016.
3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

ONLINE RESOURCES:

Solar energy basics Solar energy system design Renewable energy technology fundamentals

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Subject Name: Essential Studies for Professionals-V

Subject Code: ESPME501

Credit: 0.5

Lecture Hours:48

Module number	Topic	Sub-topics	Mapping with International/National/ State Level Exams	Lecture Hours	Corresponding Assignment
1	Engineering Mechanics	Free-body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations, collision.	National Exams: 1. GATE: https://gate2024.iisc.ac.in/wp-content/uploads/2023/07/me.pdf 2. UPSC Engineering Service Examination: https://upsc.gov.in/sites/default/files/Notification-23-engl-140922-ESEP-23-engl-140922-Final.pdf , Page- 22,23 3. UPSC Civil Service Examination: https://upsc.gov.in/sites/default/files/Notification-23-engl-010223.pdf , Page- 127- 129	16	1. Explain the concept of a free-body diagram. How does it aid in analyzing the equilibrium of a system? 2. Define trusses and frames in the context of structural engineering. Discuss the fundamental differences between them. 3. A bridge structure consists of multiple trusses connected together. Explain the advantages and disadvantages of using the method of joints compared to the method of sections for analyzing the forces in the members of such a complex frame. When might one method be preferred over the other? 4. Discuss the concept of static determinacy in trusses and frames. How does the number of supports and internal connections affect the determinacy of a structure? Provide an example of a statically determinate truss and a statically indeterminate frame.

			4. SSC Junior Engineer: (https://ssc.nic.in/SSCFfileServer/PortalManagement/UploadedFiles/NOTICE_JE_2023_2607_2023.pdf) 5. RRB JE, Technician, & Miscellaneous Category Posts: (https://wcr.indianrailways.gov.in/uploads/files/1658493303114-english%20GDCE%2002_2022.pdf)	5. What is virtual work, and how does it relate to the principle of virtual displacement? 6. Discuss the limitations of using virtual work for solving real-world engineering problems. Are there any situations where virtual work might not be a suitable approach? Explain your reasoning. 7. A cannon fires a projectile at an angle towards a target. Describe the different stages of the projectile's motion after it leaves the cannon's barrel. Explain how the initial launch angle and velocity affect the trajectory and range of the projectile using the concepts of horizontal and vertical components of motion. 8. Discuss the different types of collisions (elastic, inelastic, and perfectly inelastic) and how they are characterized based on the conservation of momentum and kinetic energy. 9. A tennis ball is served during a match. Explain the concept of impulse and how it relates to the change in momentum of the ball during the serve. Is there a transfer of momentum involved between the racket and the ball? Explain. (10 points) 10. A car is negotiating a turn on a racetrack. Describe the different types of motion the car undergoes during the turn (translation, rotation, or both). How do the concepts of angular velocity and angular acceleration relate to the car's turning behavior?	
Casting, Forming and Joining Processes	Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Plastic deformation and yield criteria; fundamentals	National Exams: 1. GATE: (https://gate2024.iisc.ac.in/wp-content/uploads/2023/07/me.pdf) 2. UPSC Engineering	32 1. Design of product by solid work which will manufacture by casting. 2. derive an equation for the solidification time for the droplet in vacuum (an analog of Chvornikov's rule). 3. Using Solidworks optimize the gating and riser system design for a complex automotive		

of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy. Principles of welding, brazing, soldering and adhesive bonding	Service Examination: https://upsc.gov.in/site/s/default/files/Notification-23-engl-140922-Final.pdf, Page- 22,23 3. UPSC Civil Service Examination: https://upsc.gov.in/site/s/default/files/Notification-23-engl-010223.pdf, Page-127- 129 4. SSC Junior Engineer: https://ssc.nic.in/SSCFileServer/PortalManagement/UploadedFiles/Notification/OTICE JE 2023 2607 2023.pdf 5. RRB JE, Technician, & Miscellaneous Category Posts: https://wcr.indianrailways.gov.in/uploads/files/1658493303114-english%20GDCE%2002_2022.pdf	eng, die block casting to minimize defects such as shrinkage porosity and ensure uniform solidification throughout the component 4. Utilizing AutoForm simulate and optimize the progressive die stamping process for a high-strength steel automotive chassis component, considering factors such as material flow, springback, and die wear, to achieve improved part quality and production efficiency. 5. simulate and optimize the roll forming process for manufacturing complex structural profiles, such as those used in the construction industry, while ensuring precise dimensional accuracy, uniform material flow, and minimizing springback effects	1. Calculate Boundary Work using Matlab 2. Using Matlab, do the first law analysis of a compressor and a turbine. 3. Create a Matlab code to calculate enthalpy and entropy of a pure substance at a given temperature and pressure. 4. Using Matlab, do the second law analysis of a compressor and a turbine. 5. Using Matlab, calculate the entropy destroyed in a compressor and a turbine. 6. Using Matlab, do the exergy analysis of a compressor.
Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behaviour of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations Engineering			

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Subject Name: Mechanical Engg Lab IIIC (Applied Thermodynamics & Heat Transfer)

Subject Code: PCCME591

Credit: 1

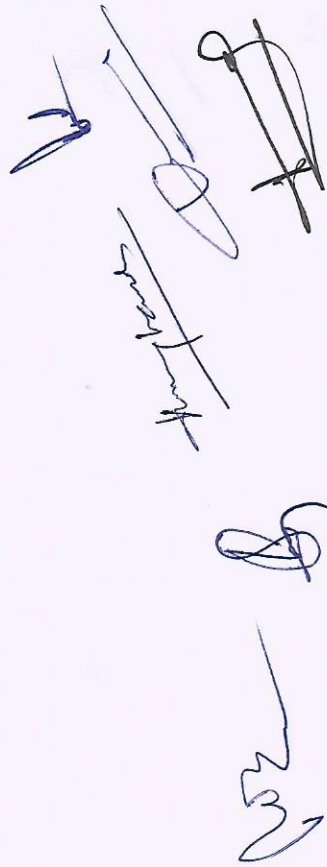
Pre-Requisites: Engineering Thermodynamics, IC Engine & Gas Turbine

Objectives:

- (i) To understand the principles and performance characteristics of thermal devices.
- (ii) To measure different thermal properties related to heat transfer equipment.

Contents (List of Experiments):

1. Determination of dryness fraction of steam by combined separating and throttling calorimeter.
2. Study and performance test of a single acting reciprocating air compressor.
3. Determination of the thermal conductivity and specific heat of given objects.
4. Determination of the convective heat transfer coefficient for flow over a heated plate.
5. Determine the overall heat transfer coefficient at the surface of a given metal pipe by the forced convection method.
6. To determine the overall heat transfer coefficient at the surface of a given vertical metal cylinder by the natural convection method.
7. Determination of thermal conductivity of an insulating powder/or an insulating plate.
8. Determination of the emissivity of a given sample.
9. Study of a shell and tube heat exchanger and determination of LMTD.



Course Outcomes:

- CO1: Recognize different modes of heat transfer and their characteristics and interpret heat transfer phenomena observed in experiments.
- CO2: Apply mathematical models of heat transfer to solve practical problems.
- CO3: Analyze experimental data to determine thermal properties of materials and heat transfer coefficients.
- CO4: Evaluate the effectiveness of different heat transfer mechanisms in various practical scenarios and create an innovative solution for enhancing heat transfer efficiency in engineering systems.

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Subject Name: Mechanical Engineering Laboratory IB (Machine Drawing)

Credit: 1

Lecture Hours: 24

Subject Code: PCCME592

Module No.	Topics	Mapping with Industry and International Academia	Laboratory Hours
1	Schematic product symbols for standard components in mechanical systems, e.g. Welding symbols, Pipe-joint symbols	AICTE prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf International Standards : https://ocw.mit.edu/courses/4-500-introduction-to-design-computing-fall-2008/ https://explorecourses.stanford.edu/search?view=catalog&filter-coursestatus=Active=on&q=ME%20181:%20Deliverables:%20A%20Mechanical%20Engineering%20Design%20Practicum&academicYear=20152016 Industry Mapping: Autodesk AutoCAD https://www.autodesk.in/products/autocad/ PTC Creo	4
2	Orthographic projections of machine elements, Different sectional views- full, auxiliary sections; Isometric projection of machine components;		4
3	Assembly and detailed drawings of various mechanical assemblies, e.g. i. Plummer block, ii. Tool head of a shaping machine, iii. Tailstock of a lathe, iv. Simple gear box, v. Flange coupling,		8
4	Welded bracket joined by stud bolt on to a structure, welded pipe joints indicating work parts before welding, etc.		2

5	Introduction to production and fabrication drawing.	https://www.ptc.com/en/products/creo	2
6	Drawing different machine components in 3D CAD environment and extracting their orthographic and isometric projections.	SolidWorks https://www.solidworks.com/product/solidworks-3d-cad	4

Course Outcomes:

After completion of this course, learner will be able to:

- CO1. Create knowledge about the various practices with regard to the dimensioning, sectioning and development of views.
- CO2. Understand the importance of the linking functional and visualization aspects in the preparation of the part drawings
- CO3. Prepare part or assembly drawings as per the conventions.
- CO4. Interpret of machine drawings that in turn help the students in the preparation of the production drawings.

Learning Resources

1. N. D. Bhatt , Machine Drawing, Charotar Publishing House
2. K. L. Narayana, P. Kannaiah, K. Venkata Reddy, Machine Drawing, New AGE International Publishers
3. R. K. Dhawan, A Textbook of Machine Drawing, S Chand & Company.

Subject Name: Mechanical Engg Lab IC (Kinematics & Dynamics of Machines)

Subject Code: PCCME593

Credit: 1

Lecture Hours: 24

Pre-requisite: Engineering Mechanics (Statics), Engineering Mechanics (Dynamics)

Relevant Link: STUDY MATERIAL

NPTEL

COURSERA (1 & 2)

Course Objectives:

To understand the deformation behaviour of materials

To understand the kinematic and dynamic characteristics of mechanical devices

Course Contents (experiments/ problems/ studies are to perform):

Topic	Mapping with Industry and International Academia	Corresponding Lab Assignment
1. To study various types of gear and gear trains.	<i>AICTE prescribed syllabus:</i>	1. Visual study of some basic mechanism

2. Determination of velocity ratios of simple, compound, epicyclic and differential gear trains and to evaluate torque and energy required 3. Studying kinematics of four bar, slider crank, crank rocker, double crank, double rocker and oscillating cylinder mechanisms 4. Studying kinematics of typical mechanisms like pantograph, some straight-line motion mechanisms, wiper, drafter, etc. 5. Motion studies of different cams & followers. Draw displacement diagram, velocity diagram & acceleration diagram of cam follower. 6. Single degree of freedom Spring-mass-damper system: determination of natural frequency and damping coefficient 7. Determination of torsional natural frequency of single and double rotor systems- undamped and damped natural frequencies 8. Studying machine vibration using sensor 9. Solving simple balancing problems experimentally	https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf International Standards: https://ocw.mit.edu/courses/2-12-introduction-to-robotics-fall-2005/resources/chapter4/ Industry Mapping: SOLIDWORKS Motion Simulation https://help.solidworks.com/2021/english/SolidWorks/motionstudies/c_motion_analysis.htm Physical inspection of cam-follower mechanisms in machines Hexagon ADAMS Simulation Dynamic analysis of single and multi DOF systems using Hexagon ADAMS Simulation https://hexagon.com/products/product-groups/computer-aided-engineering-software/adams Physical inspection of different types of gears in motion in machines SOLIDWORKS Motion Simulation https://help.solidworks.com/2021/english/SolidWorks/motionstudies/c_motion_analysis.htm Demonstration of static and dynamic balancing in the laboratory (in a smaller version of an industrial machine)	2. Kinematic study of some simple mechanics using manual calculations and validating the results with SOLIDWORKS Motion Simulation 3. Kinematic study of different types of cam-follower pairs using manual calculations and validating the results with ADAMS Simulation 4. Kinematic study of different types of gears using SOLIDWORKS Motion Simulation 5. Balancing of an unbalanced rotating mass system using manual calculation and applying in actual setup. 6. Calculating the gyroscopic couple manually and validate with experimental results 7. Calculating dynamic parameters of vibrating systems using manual calculations and validating the results with ADAMS Simulation
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Course Outcomes:

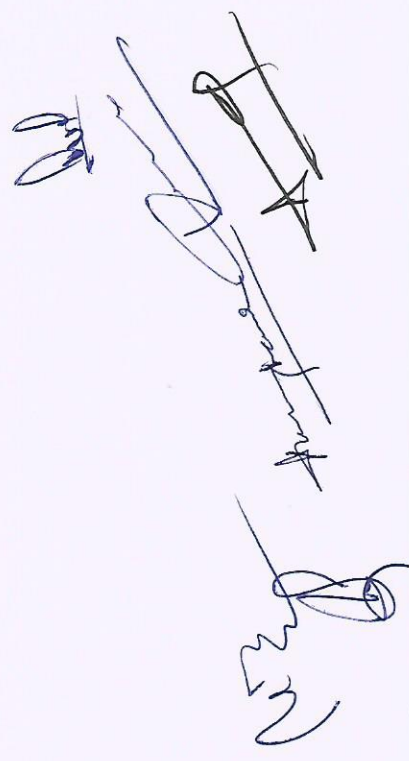
After completing this course,

1. The students can design various types of linkage mechanisms for obtaining specific motion and analyze them for optimal functioning.
2. They can understand the kinematics and rigid-body dynamics of kinematically driven machine components

3. They can understand the kinematics of gear trains and cam systems to generate specified output motion
4. They can understand the application of balancing, flywheel and gyroscope and concept of vibration.

Learning Resources:

1. Theory of machine by S S Ratan, McGraw Hill Education India Private Limited
2. A. Ghosh and A.K. Mallick, Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd., New Delhi, 1988.
3. T. Bevan, Theory of Machines, 3rd Edition, CBS Publishers & Distributors, 2005.
4. A. Shariff, Theory of Machines, Dhanpat Rai Publication, New Delhi, 2000.
5. W.L. Cleghorn, Mechanisms of Machines, Oxford University Press, 2005.
6. R.L. Norton, Kinematics and Dynamics of Machinery, 1st Edition, McGraw Hill India, 2010.



Subject Name: Mechatronics, Robotics & Control lab

Credit: 1

Lecture Hours: 24

Subject Code: PCCME594

Pre-requisite: Kinematics of Machines, Mathematics

COURSE OBJECTIVES:

1. To synergies the combination of mechanical, electronics, control engineering and computers.
2. To foster critical thinking and innovation by encouraging students to explore emerging technologies, research trends, and novel applications in mechatronics and robotics.



COURSE CONTENT:

Details of Experiments	Mapping
1. Modeling and Simulation of a Robotic Arm using MATLAB (Simulink/Simscape) 2. Study of a Robotic Arm 3. Experiment on LVDT for displacement measurement 4. Study of PLC 5. Study of a Microcontroller 6. Study of a Microprocessor (8086) 7. Cut-section of a solenoid valve 8. Experiment on Pneumatic servo system 9. Experiment on Hydraulic servo system 10. Verification of P, P+I, P+I+D control actions controller	International Academia: (https://cs.stanford.edu/groups/manips/teaching/cs223a/) AICTE-prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Mechatronics/mechatronics.pdf) Industry Mapping: MATLAB (Simulink/Simscape)

COURSE OUTCOMES:

CO1: Students will acquire proficiency in software tools commonly used in mechatronics and robotics, such as MATLAB (Simulink/Simscape).

CO2: Students will develop problem-solving skills by analyzing, designing, and implementing solutions to real-world engineering challenges encountered in mechatronics and robotics.

Subject Name: Project-III

Credit: 1

Subject Code: PRJME581

L-T-P : 0-0-2

Pre-Requisites: Project I (CAD Based), Project II (Research Methodology)

Course Objective(s):

The purpose of learning of this course is to:

1. To demonstrate their technical skills, and put in practice their experiences and knowledge.
2. To identify suitable problem/research gap through literature review and solve the real-life problems faced by the society.
3. To design engineering solutions to complex problems utilizing a systems approach either through simulation, theoretical or experimentation work.
4. Analyze and evaluate the work comprehensively through presentation and develop a comprehensive project report.
6. Create a solution for the society and present his/her work in a conference or publish the work in a peer reviewed journal.

Course Content.

Sl. No.	Contents	Hours
1	Understanding the language of research – concept, construct, definition, variable research process, literature review	4
2	Problem identification & formulation of research gap	4

3	Development of project plan and formulate of the design of experiment.	4
4	Market Survey & Estimation of Budget for the project work	4
5	Modelling, simulation or Fabrication or the Project as per the requirement.	4
6	Optimization of the prototype or model for holistic development.	2
7	Publication of the work and dissemination through conference and journal publication.	2

Course Outcome:

- CO1: Understand the problem/research gap through literature review for solving the real-life problems.
- CO2: Apply the developed solution either through practical work or through simulation, theoretical or experimental work.
- CO3: Analyze & evaluate the results and further optimize as per the project requirements.
- CO4: Understand the importance of team work and create technical solution through delivery of the project goal.

Learning Resources:

1. Kothari, C.R, and Garg, G., (2019), Research Methodology - Methods and Techniques, 4th Edition, New Age International Publishers.
2. Catherine Dawson, (2019), Introduction to Research Methods by, 5th Edition, Robinson
3. Bordens, K. S. and Abbott, B. B. (2013) Research Design and Methods – A Process Approach. 9th Edition, McGraw-Hill.

Subject Name: Seminar & Communication 2 Credit: 1 Lecture Hours: 24

Subject Code: HSMME582

RELEVANT LINK:

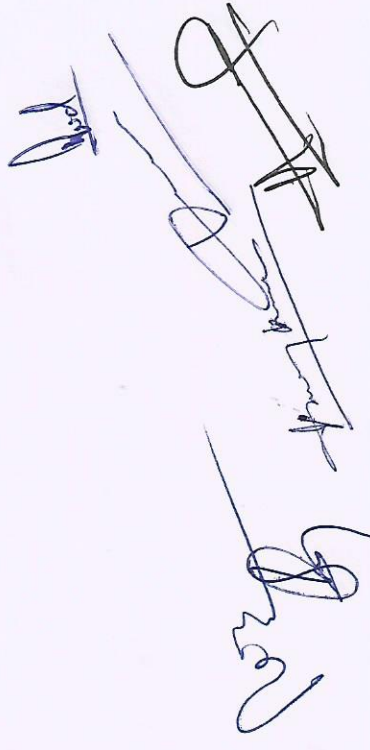
[LINKEDIN LEARNING](#)

COURSE OBJECTIVE:

To impart knowledge on the correct use of the English language for technical and interpersonal communication.

COURSE OUTCOME:

The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.



COURSE CONTENT:

Module number	Topic	Sub- topics	Mapping with International/National/ State Level Exams	Lecture Hours	Corresponding Assignment
1	General vocabulary	The concept of Word Formation; Root words from foreign languages and their use in English; Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives; Synonyms, antonyms, and standard abbreviations.	International Exams - GRE (https://www.ets.org/gre/test-takers/general-test/prepare/content/verbal-reasoning.html#accordion-9f58105fc6-item-88093eca37) - GMAT (https://downloads.mba.com/downloads/gmat-handbook.pdf) National Exams - UPSC Civil Services Exam (https://upsc.gov.in/sites/default/files/Notif-CSP-23-engl-010223.pdf), pg 25-26 - UPSC Combined Defence Services (https://upsc.gov.in/sites/default/files/Notif-CDS-I-Exam-2023-Engl-211222.pdf), pg 20-21 - RBI Grade B (https://rbidocs.rbi.org.in/rdo/cs/Content/PDFs/DADVTGRB09052023FA65E4FB1C2CF473396B4FD7E5F69CDDDE.PDF), pg 22-23 - XAT (https://xat.org.in/xat-syllabus/) - GATE (https://gate2024.iisc.ac.in/papers-and-	12	Choose a topic or theme and list down 10 words associated with it. Find one synonym and one antonym for each word. Create a meaningful paragraph using the 10 chosen words. Recite the same with the correct verbal expressions in class. Generate a paragraph using the same set of words using ChatGPT and compare your original paragraph with the one framed by ChatGPT.

			syllabus/ 6. CAT (2IIM-CAT-Exam-Syllabus-2024.pdf)		
2	Grammar & Verbal Reasoning Parts of speech; Active and Passive Voice; Direct and Indirect Speech; Reading Comprehension	International Exams 1. GRE (https://www.ets.org/gre/test-takers/general-test/prepare/content/verbal-reasoning.html#accordion-9f58105fc6-item-88093eca37) 2. GMAT (https://downloads.mba.com/downloads/gmat-handbook.pdf) National Exams 1. UPSC Civil Services Exam (https://upsc.gov.in/sites/default/files/Notif-CSP-23-engl-010223.pdf), pg 25-26 2. UPSC Combined Defence Services (https://upsc.gov.in/sites/default/files/Notif-CDS-I-Exam-2023-Engl-211222.pdf), pg 20-21 3. RBI Grade B (https://rbidocs.rbi.org.in/rdocs/Content/PDFs/DADVGTGRB09052023FA65E4FB1C2CF473396B4FD7E5F69CDDE.PDF), pg 22-23 4. XAT (https://xat.org.in/xat-syllabus/) 5. GATE (https://gate2024.iisc.ac.in/papers-and-syllabus/) 6. CAT (2IIM-CAT-Exam-Syllabus-	12	Assignment sheet on verbal reasoning to be answered and submitted.	

3	Creative writing	Precise Writing; Email Technical Writing and Essay Letter Writing; Report	2024.pdf	International Exams 1. GRE (https://www.ets.org/gre/test-takers/general-test/prepare/content/verbal-reasoning.html#accordion-9f58105fc6-item-88093eca37) 2. GMAT (https://downloads.mba.com/downloads/gmat-handbook.pdf) National Exams 1. UPSC Civil Services Exam (https://upsc.gov.in/sites/default/files/Notif-CSP-23-engl-010223.pdf), pg 25-26 2. UPSC Combined Defence Services (https://upsc.gov.in/sites/default/files/Notif-CDS-I-Exam-2023-Engl-211222.pdf), pg 20-21 3. RBI Grade B (https://rbidocs.rbi.org.in/rdo/cs/Content/PDFs/DADVGTGRB09052023FA65E4FB1C2CF473396B4FD7E5F69CDDE.PDF), pg 22-23 4. XAT (https://xat.org.in/xat-syllabus/) 5. GATE (https://gate2024.iisc.ac.in/papers-and-syllabus/) 6. CAT (2IIM-CAT-Exam-Syllabus-2024.pdf)	12	1. One technical report on any topic relevant to the course is to be submitted. 2. Write an original short story and present the same in class.
4	Oral Communication	Creating a YouTube channel to create and upload original content;	International Exams 1. GRE (https://www.ets.org/gre/test-2024.pdf)	12	1. Choose a theme on which you must create original content and post the same on	

tion	Group discussions; Debates; Seminars	<u>takers/general-test/prepare/content/verbal-reasoning.html#accordion-9f58105fc6-item-88093eca37)</u> 2. GMAT (https://downloads.mba.com/downloads/gmat-handbook.pdf) National Exams 1. UPSC Civil Services Exam (https://upsc.gov.in/sites/default/files/Notif-CSP-23-engl-010223.pdf), pg 25-26 2. UPSC Combined Defence Services (https://upsc.gov.in/sites/default/files/Notif-CDS-I-Exam-2023-Engl-211222.pdf), pg 20-21 3. RBI Grade B (https://rbidocs.rbi.org.in/rdocs/Content/PDFs/DADVTGRB09052023EA65E4FB1C2CE473396B4FD7E5F69CDDE.PDF), pg 22-23 4. XAT (https://xat.org.in/xat-syllabus/) 5. GATE (https://gate2024.iisc.ac.in/papers-and-syllabus/) 6. CAT (2IIM-CAT-Exam-Syllabus-2024.pdf)	YouTube. 2. Present a seminar on a topic of your choice.
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Text Book:

1. English Grammar & Composition. Wren & Martin, Revised by N.D.V. Prasada Rao, S. CHAND & COMPANY LTD.
2. AICTE's Prescribed Textbook: English (with Lab Manual) ISBN: 978-93-91505-097

Reference Books:

1. Effective Communication Skills. Kul Bhushan Kumar, Khanna Book Publishing, 2022.
2. Practical English Usage. Michael Swan. OUP. 1995.
3. Remedial English Grammar. F.T. Wood. Macmillan. 2007
4. On Writing Well. William Zinsser. Harper Resource Book. 2001
5. Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
6. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
7. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

Handwritten signatures and initials in blue ink, including a large signature that appears to read "Vijay" and several other marks.

Subject Name: Energy storage systems for renewables

Credit: 3

Subject Code: SEEME501

Lecture Hours: 40 [Lecture (10 hours), Practical (20hours) , Social(10 hours)]

Pre-requisite: Energy and its Resources SEEME401

Relevant Links:

STUDY MATERIAL

NPTEL

COURSE OBJECTIVES:

Course Objective:

This course will offer

- An overview of the storage system suitable for offering reliable energy solutions.
- Energy storage types based on energy form
- Sustainable storage solutions for renewable energy systems will be identified based on reliability and affordability.
- Life cycle cost, energy and environmental analysis of conventional storage systems
- Study of the characteristics of conventional energy storage systems

COURSE OUTCOMES:

- CO1: Understanding about the different types of demand supply mismatches in a renewable system



- CO2: Understanding of basic operating principle of different storage systems
- CO3: Ability to analyze the life cycle energy cost of different energy storage system
- CO4: Knowledge of characteristics behavior of different storage systems

Course Content

A. Theoretical Learning

Lecture No.	Contents
1	Demand-supply mismatch and role of energy storage: Discussion on types and variation in different load demands such as residential load, office, agricultural load; Variation in renewable energy resources, Understanding the mismatch between load profile and generation profile; introduction to the mismatch time scale
2	Overview of different energy storage options: Introduction to the Ragone plot; Introduction of demand-supply mismatch time scale on Ragone plot; C-rating
3	Mechanical Energy Storage-Compressed Air: Basic thermodynamics; working principle; general consideration; power extraction system-diabatic, adiabatic and isothermal method
4	Mechanical Energy Storage-Flywheel: Introduction to the moment of inertia, angular momentum and kinetic energy of rotating object; working principle; components; characteristics; applications
5	Mechanical Energy Storage-Pumped Hydro: Introduction; working principle; components and complete system; open-loop and closed-loop pumped hydro storage; turbines types and applications
6	Thermal Energy Storage: Introduction to the fluid flow and heat transfer; latent and sensible heat storage; phase change materials (PCM) for thermal energy storage; different geometries for PCM based thermal storage
7	Overview of Electrochemical Energy Storage: Electrochemical cells and batteries; primary cell; secondary cell, Faradic and Non-faradic process, charging and discharging of electrochemical cells and polarity, efficiencies
8	Open circuit voltage for electrochemical storage: Standard pressure and temperature, standard electrode potential, concentration cell

9	Current-voltage behaviour of electrochemical storage: Types of electrode electrolyte interfaces, double layer capacitance, mechanism of electron transfer at the interface, oxidation and reduction and polarity, anode and cathode, cell polarisation behaviour-activation polarisation, ohmic polarisation, concentration polarisation
10	Supercapacitor as energy storage: Introduction, working principle, basic design, types, charging-discharging characteristics and efficiencies, applications
11	Batteries storage: Introduction to Primary battery, reserve batteries and secondary batteries, Lead-acid batteries- working principle, components and characteristics, Li-ion batteries- working principle, components and characteristics
12	Hydrogen storage: Introduction to water electrolysis, alkaline electrolyser, PEM electrolyser, current-voltage characteristics, materials for electrolyser, engineering configurations
13	Hybrid energy storage: Introduction to hybrid energy storage, C-rating of a storage system, Life of energy storage, studying the demand-supply mismatch and selection of storage system
14	Flow batteries: Working principle, Types of flow battery, components and configurations, current-voltage characteristics, efficiencies, lifetime
15	Life cycle analysis: Depth of discharge and state of charge, cycle life of a battery as a function of depth of discharge, full effective cycle, shelf life, life cycle cost analysis, environmental impact and recycling,

B. Practical Learning

The duration of each experiment is for 3 hours.

Experiment No.	Contents
1	Study the characteristics of a lead-acid battery, note down the parameters on charging and discharging cycles
2	Study the characteristics of a flywheel Reference link: https://vlab.amrita.edu/?sub=1&brch=74&sim=571&cnt=3
3	Study the behaviour of different electrodes for electrochemical energy storage
4	Study the thermal behaviour of different phase change material

C. Social Learning

Social experiment No.	Contents
1	Visit an office / industry / any other place (it may be there in your own institution) where battery based storage is installed. Observe the kind of batteries installed, their configuration, ratings of individual battery and that of combined storage, back-up that battery storage is performing.
2	Prepare a report on Lead-acid battery recycling. If possible, visit a factory premises where batteries are manufactured or recycled. Identify aspects of battery manufacturing and recycling that would environmental impact.
3	Prepare brief report on any one of the following energy storage (more than 100 kWh) mechanisms based on actual installations: pump storage / H ₂ storage / battery storage

TEXT BOOK:

1. A.G.Ter-Gazarian, "Energy Storage for Power Systems", Second Edition, The Institution of Engineering and Technology (IET) Publication, UK, (ISBN - 978-1-84919-219-4), 2011
2. Robert A. Huggins, "Energy Storage", Springer Science (ISBN - 978 -1-4419-1023-3), 2010
3. R. Pendse, "Energy Storage Science and Technology", SBS Publishers & Distributors Pvt. Ltd., New Delhi, (ISBN - 13:9789380090122), 2011

ONLINE RESOURCES: COURSERA (course 1)

COURSERA (course 2)

MANDATORY ADDITIONAL REQUIREMENT (MAR)

- Tech Fest/Fest/Teachers' Day/Fresher's Welcome
- Rural Reporting
- Tree Plantation
- Participation in Relief Camps (Collection of funds/materials for the Relief Camp)
- Animal Welfare Camp
- Participation in Debate/Group Discussion/Tech Quiz/Quiz
- Publication of Wall Magazine in institutional level (magazine/article/internet)
- Publication in Newspaper, Magazine and Blogs
- Research Publication
- Innovative Projects (other than course curriculum)
- Blood donation
- Participation in Sports/Games (College level /University level / District level / State level National/International Level)
- Cultural Programme (Dance, Drama, Elocution, Music etc.)
- Member of Professional Society /Student Chapter
- Relevant Industry Visit & Report
- Activities in different Clubs (Photography / dance/drama etc. Club)
- Participation in Yoga Camp
- Adventure Sports with Certification
- Training to under-privileged/differently able
- Community Service & Allied Activities
- Self-Entrepreneurship Programme (Organize Entrepreneurship Workshop /To take part in Entrepreneurship Workshop /Video Film-Making on Entrepreneurship /Submit Business Plan on any / To work for start-up/as entrepreneur)

